

REMARKS/ARGUMENTS

Favorable reconsideration of this application in view of the above amendments and following remarks is respectfully requested.

By this amendment, Claims 26, 30, 33 and 36-37 are amended; Claims 51-52 are added; and no claims are canceled herewith. Support for the amendments can be found at least in paragraphs [0036, 0041, 0051, 0053, 0063]. It is respectfully submitted that no new matter is added by this amendment.

In the outstanding Office Action, Claims 26-28, 31 and 37 were rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Patent No. 6,191,053 to Chun in view of U.S. Patent No. 6,416,583 to Kitano; Claims 29 and 30 were rejected under 35 U.S.C. §103(a) as unpatentable over Chun and Kitano and in further view of U.S. Patent No. 5,499,733 to Litvak; Claims 32-34 were rejected under 35 U.S.C. §103(a) as unpatentable over Chun, Kitano, Litvak and further in view of U.S. 2002/0000193 to Kitano; Claim 35 was rejected under 35 U.S.C. §103(a) as unpatentable over Chun and Kitano and further in view of U.S. Patent No. 3,953,265 to Hood; and Claim 36 was rejected under 35 U.S.C. §103(a) as unpatentable over Chun and Kitano and further in view of U.S. Patent No. 6,656,277 to Sanada.

With respect to the rejections under 35 U.S.C. §103, those rejections are respectfully traversed. In particular, it is respectfully submitted that the applied art does not teach or suggest that a control unit controls the developer nozzle such that a) the developer nozzle is moved from a peripheral portion of the substrate toward the center portion of the substrate while ejecting the developing solution and while rotating the substrate around the vertical axis at a rotation speed not less than 500 rpm, and b) after a), the developer nozzle is stopped above the center portion of the substrate while ejecting the developing solution, as recited in Claim 26.

In accordance with the features of the claimed invention, as discussed in [0037] for example, the developing solution spreads radially outwardly from a position on which the developing solution falls onto the substrate, whereby a continuous thin liquid film of the developing solution is formed in an annular area extending from a position to the periphery of the substrate, and the annular area spreads inwardly toward the center of the substrate. Any point on the substrate surface which has been once wetted with the developing solution will never dry (i.e., not coated with developing solution) until the developing solution supplying position reaches the center of the substrate.

Moreover, according to the feature b) of Claim 26 discussed above, as the developing solution supplied continuously for a while after the developing solution supplying position reaches the center of the substrate, the developing solution spreads radially outwardly, whereby the continuous liquid film of the developing solution extending over the whole surface without discontinuity (i.e., there is no area which is not covered with the developing solution) is maintained. Any point within the substrate surface which has been once wetted with the developing solution will never dry (i.e., not coated with developing solution) until the supply of the developing solution is stopped. In this way, the developing time can be adjusted by varying the developing solution supplying time after the developing solution supplying position reaches the center of the substrate, as discussed in paragraph [0053] for example.

In contrast, Chun discusses a photoresist coating apparatus, not a developing apparatus. Further, Chun fails to teach or suggest the rotation speed as specifically recited with respect to rotating the substrate round the vertical axis at a rotation speed not less than 500 rpm as claimed in feature a) of Claim 26. Moreover, Chun fails to teach or suggest the claimed feature b) of the present invention that the developer nozzle is stopped above the center portion of the substrate while ejecting the developing solution. As discuss in column

12, lines 12-37 of Chun, the supply of photoresist is stopped immediately when the nozzle (extrusion head 30) reaches the center of the substrate.

Kitano discusses a coating apparatus, which may be a photoresist coating apparatus and a developing apparatus. The outstanding Office Action asserts on page 4 that Kitano teaches a coating apparatus that may be used for both a photoresist coating process and a developing process, Chun's apparatus may also be used as a developing process, and thus the claimed invention is obvious. However, similar to Chun discussed above, Kitano also fails to teach or suggest the claimed features a) and b) of the claimed invention discussed above. Kitano merely discusses some combinations of nozzle movement and substrate movement (rotating or static), but no combinations correspond to the features a) and b), as claimed. Thus, even if Chun and Kitano could be appropriately combined, any possible combination lacks at least the features a) and b) of the present invention.

The remaining applied art does not make up for the deficiencies of Chun and Kitano discussed above. For example, Litvak discusses an apparatus that can be used as a developing apparatus. In Fig. 2 of Litvak the substrate appears to be rotated, however, Litvak fails to teach or suggest the features a) and b) of the claimed invention. Kitano (US 2002/0000193) is silent on the detailed movement of the nozzle, and appears to discuss that the nozzle is held in a position right above the center of the substrate. Thus, Kitano '193 fails to teach or suggest the features a) and b) of the present invention.

Hood discusses a developing process that is performed by a so-called static development, which supplies a developing liquid onto the center of the substrate without rotating the substrate, thereby form a meniscus-contained fluid body. As such, Hood fails to teach or suggest the claimed features discussed above. Sanada discusses a developing process that employs a so-called scan coating process, which supplies a developing liquid from a so-called slit nozzle whose width is slightly larger than the diameter of the substrate

but does not rotate the substrate. Thus, Sanada fails to teach or suggest the claimed features discussed above.

Additionally, the applied art does not teach or suggest a moving mechanism that moves the rinse liquid nozzle in a substantially radial direction of the substrate, and the control unit is also configured to control the rinse liquid nozzle and the moving mechanism for the rinse liquid nozzle such that, before two seconds have passed from a point of time when the supplying of the developing solution is stopped, the rinse liquid nozzle starts supplying the rinse liquid to the center portion of the substrate that is rotating, with the rinse liquid nozzle being located above the center portion of the substrate, as recited in Claim 36. Further, the features recited in new Claim 51 with respect to how the rinse liquid nozzle is held by the arm for example, and new Claim 52 are not taught by the applied art.

Applicants submit that there is no teaching or suggestion for how or why one skilled in the art would selectively pick and choose from the features of the cited references to arrive at the combined features of the present claims, which are not taught by even the combined teachings of the cited references. Moreover, the cited references do not recognize the advantageous results achieved by the present invention as discussed further below, thus further demonstrating the non-obviousness of the present claims.

In accordance with the present invention, Applicants have recognized a combination of features which provides advantageously for having the radially-spreading developing solution under the substrate rotation speed not less than 500rpm effectively removes resist-dissolving components from the resist surface, specifically from the valley portions of the resist pattern, whereby adverse effect of the resist-dissolving components can be avoided, and as a result, a resist pattern having precise line-width can be achieved. Please see the discussion in at least paragraph [0045] and the last sentence in paragraph [0036].

Furthermore, in a developing apparatus (first type) which applies a developing liquid from a nozzle located above the rotation center of a rotating substrate, the developing liquid spreading outwardly may possibly be divided into several branches. Such a phenomenon is likely to occur if the substrate surface is water-repellent. If such a phenomenon occurs, the water-repellency of areas which have been once wetted with the developing liquid is reduced, while the water-repellency of areas which have not been wetted with the developing liquid is maintained. As a result, during spreading outwardly, the developing liquid is likely to flow through areas having thus-reduced water-repellency -selectively, resulting in in-plane non-uniformity of the developing result. In order to avoid this, the amount of the developing liquid must be increased; and/or pre-wet treatment must be performed. On the contrary, one or more examples of the present invention reduces the need for taking such countermeasures. In another developing apparatus (second type) which applies a developing liquid from a nozzle moving from the center portion of the substrate toward the periphery of substrate, the same problem as that associated with the developing apparatus of the first type exists. Moreover, after the nozzle leaves the center portion of the substrate, as the developing liquid existing on the center portion of the substrate spreads radially outwardly due to centrifugal force, the center portion of the substrate will dry, resulting in in-plane non-uniformity of the developing result.

The features of the claimed invention are not taught by the applied art and therefore, the applied art cannot provide at least the advantages discussed above. Additionally, as discussed above, even if any two or more of the cited references could be appropriately combined, any possible combination would be different from the claimed invention of amended Claim 26.


Accordingly, withdrawal of the rejections under 35 U.S.C. §103(a) is respectfully requested.

Consequently, for the reasons discussed in detail above, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal allowance. Therefore, a Notice of Allowance is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact the undersigned representative at the below-listed telephone number.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, L.L.P.



Steven P. Weihrouch
Attorney of Record
Registration No. 32,829

Customer Number

22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/09)

Kevin M. McKinley
Registration No. 43,794

3610841_1.DOC